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Holderman et al.

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(54) **MECHANICALLY ADJUSTABLE FLOW CONTROL ASSEMBLY**

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E21B 43/14 (2006.01)

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CPC *E21B 34/14* (2013.01); *E21B 43/12* (2013.01)

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USPC 166/373, 386, 320, 332.2, 332.4, 240, 166/331, 334.1
See application file for complete search history.

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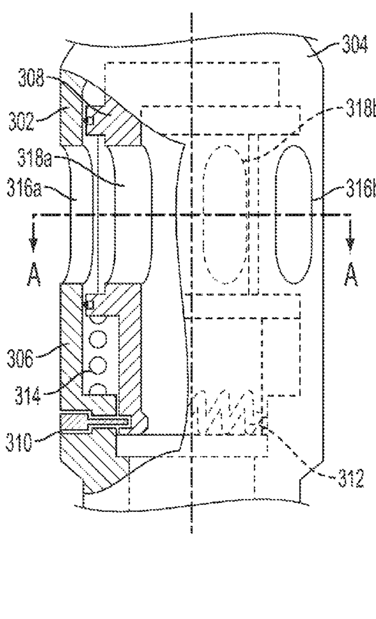
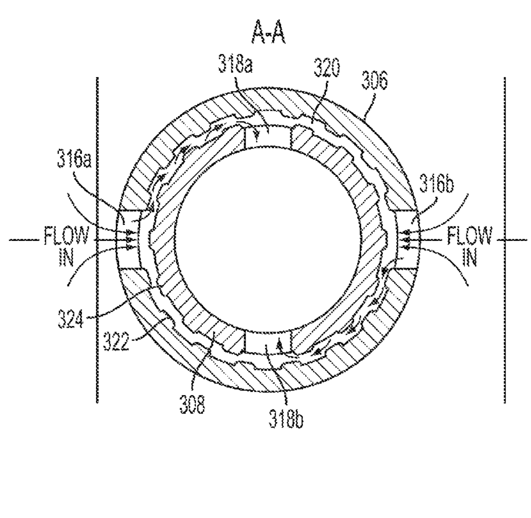
(57) **ABSTRACT**

A flow control assembly can be mechanically adjusted, rotationally or translationally, inside a tubing downhole between multiple positions by an intervening tool from the surface to change resistivity to flow through the flow control assembly. The positions among which the flow control assembly can be adjusted can include a closed position, a fully open position, and positions at which fluid experiences various resistances prior to flowing to an inner area of the tubing.

9 Claims, 11 Drawing Sheets





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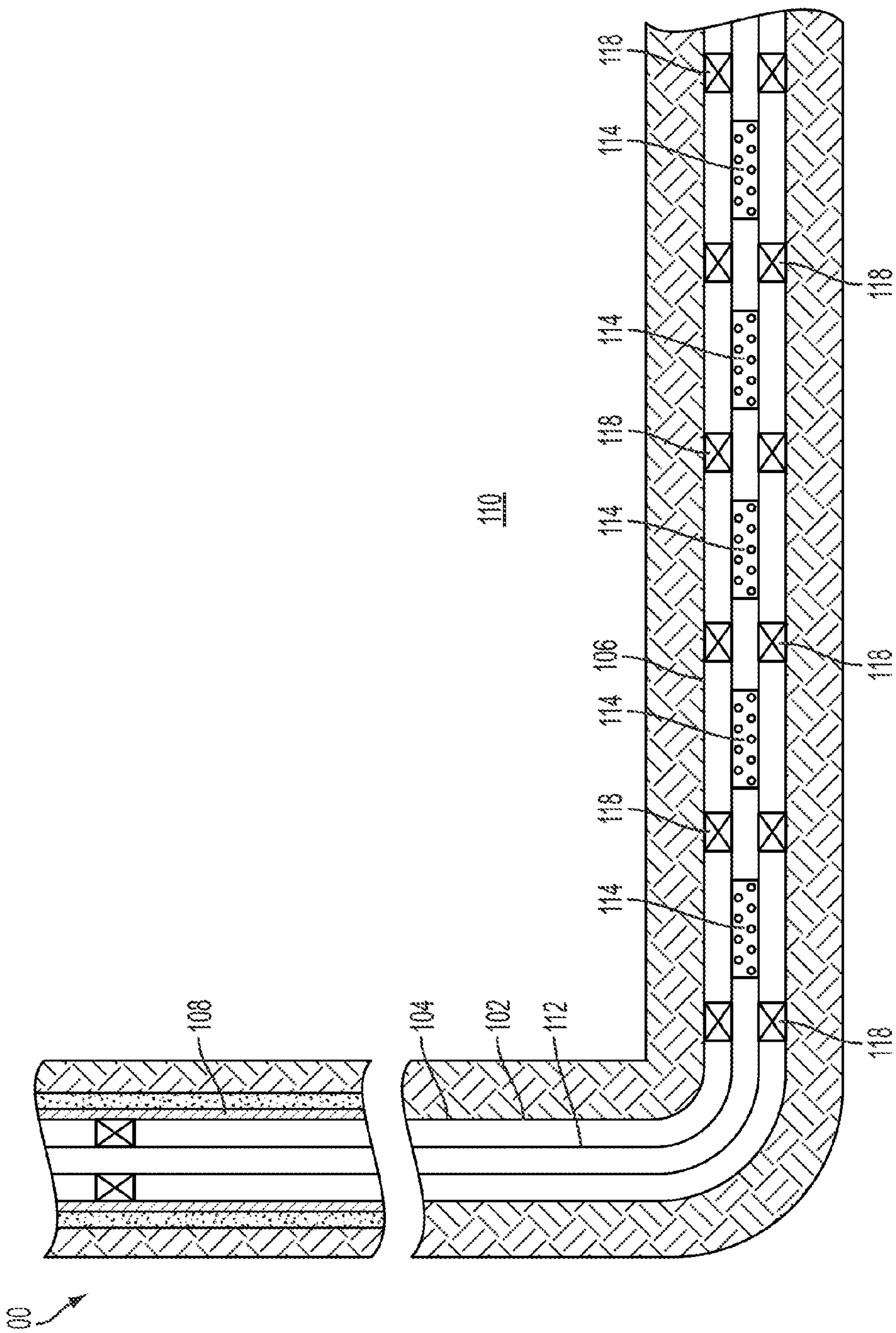

FIG. 1

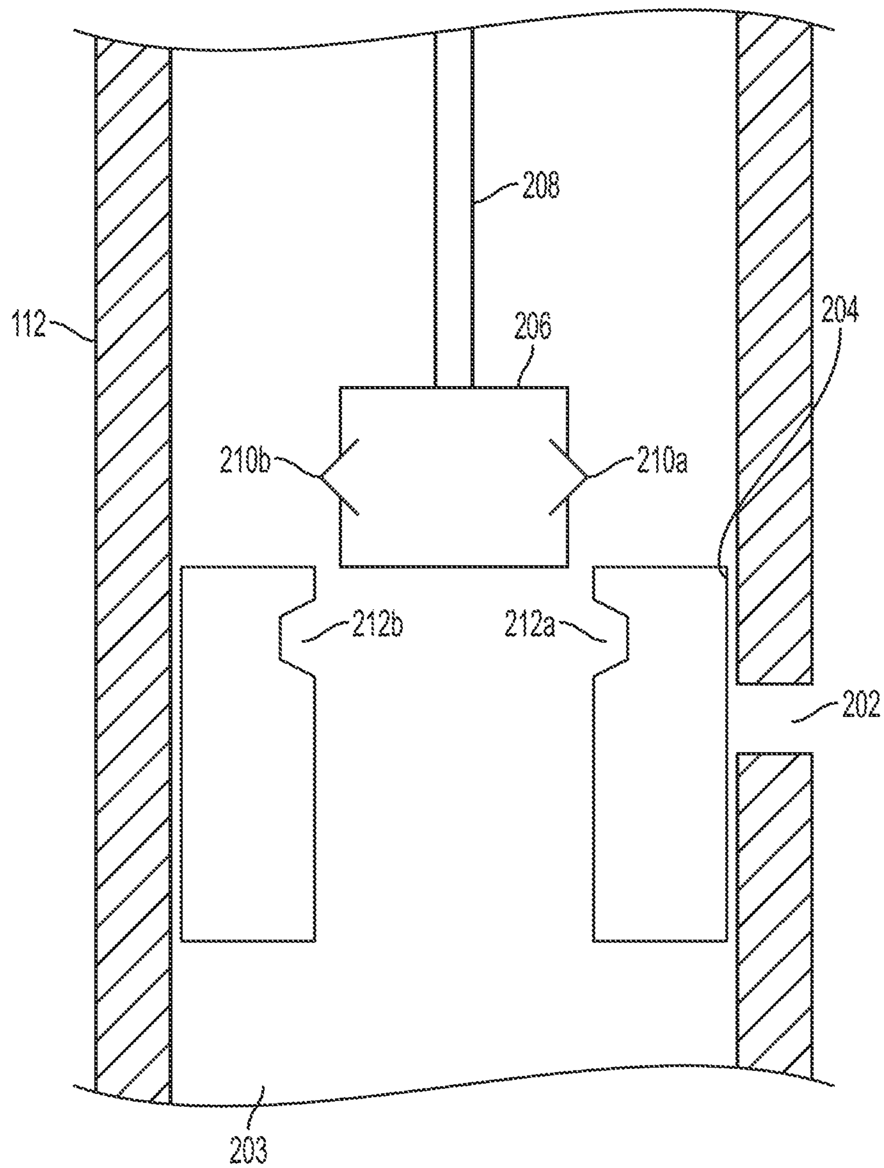

FIG. 2

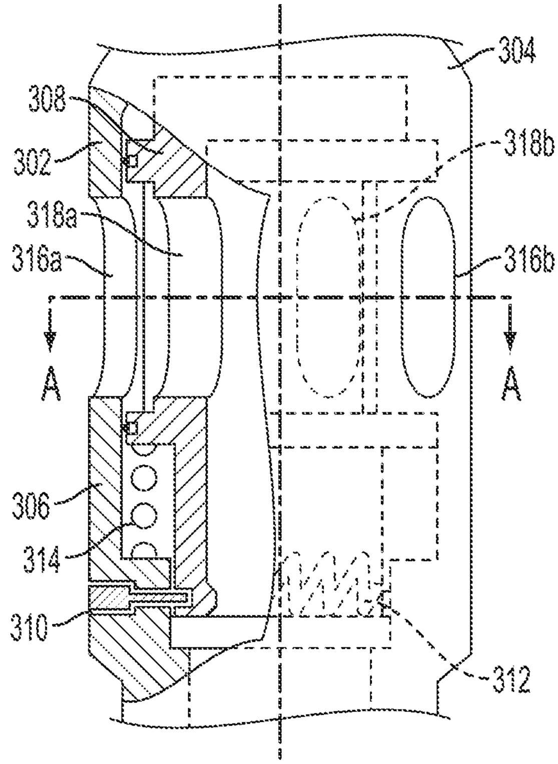
304
308
302
318b
318a
316a
316b
A
A
306
314
310
312

FIG. 3

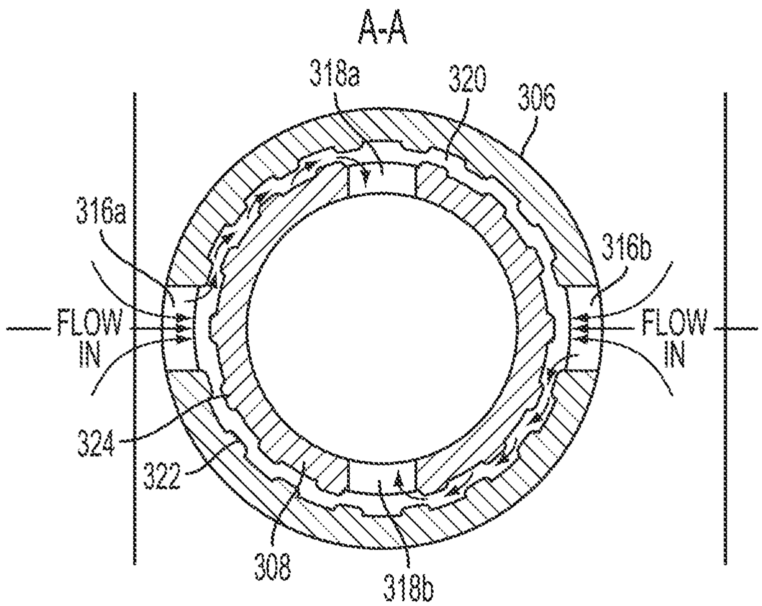
A-A
318a
320
306
316a
316b
FLOW IN
FLOW IN
324
322
308
318b

FIG. 4

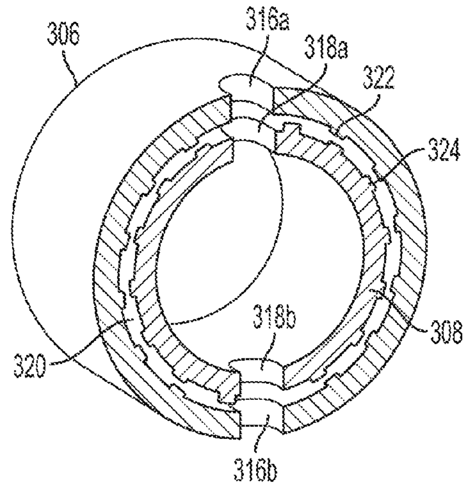

FIG. 5

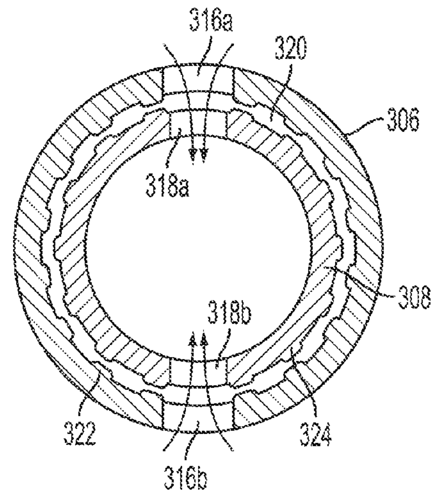

FIG. 6

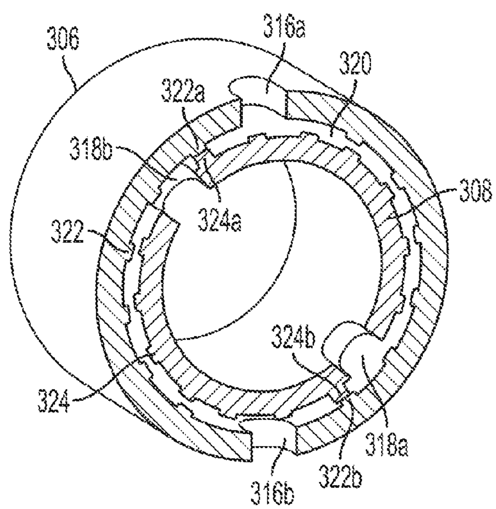

FIG. 7

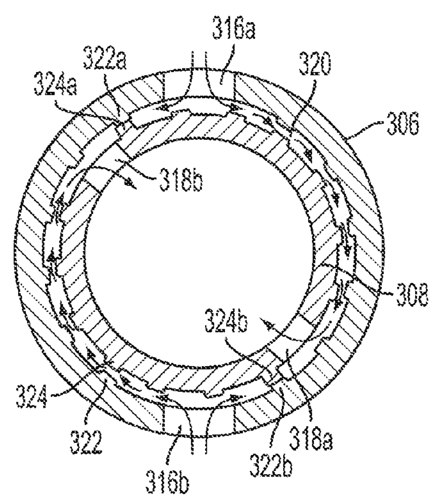

FIG. 8

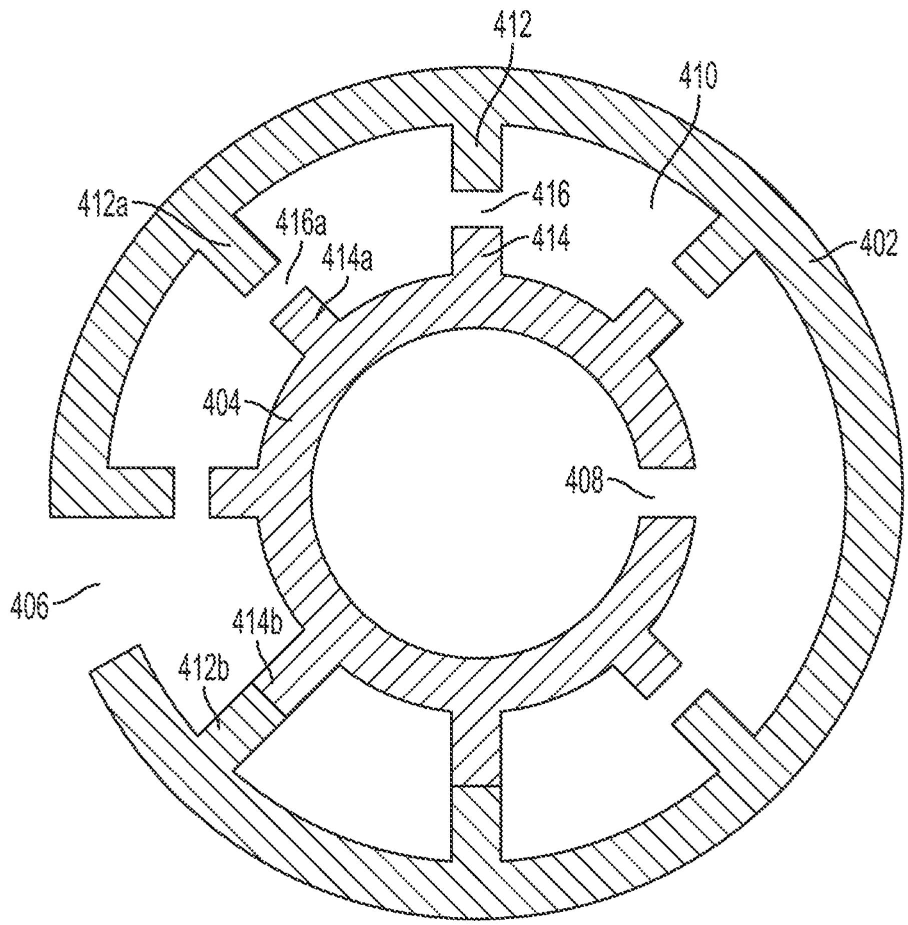

FIG. 9

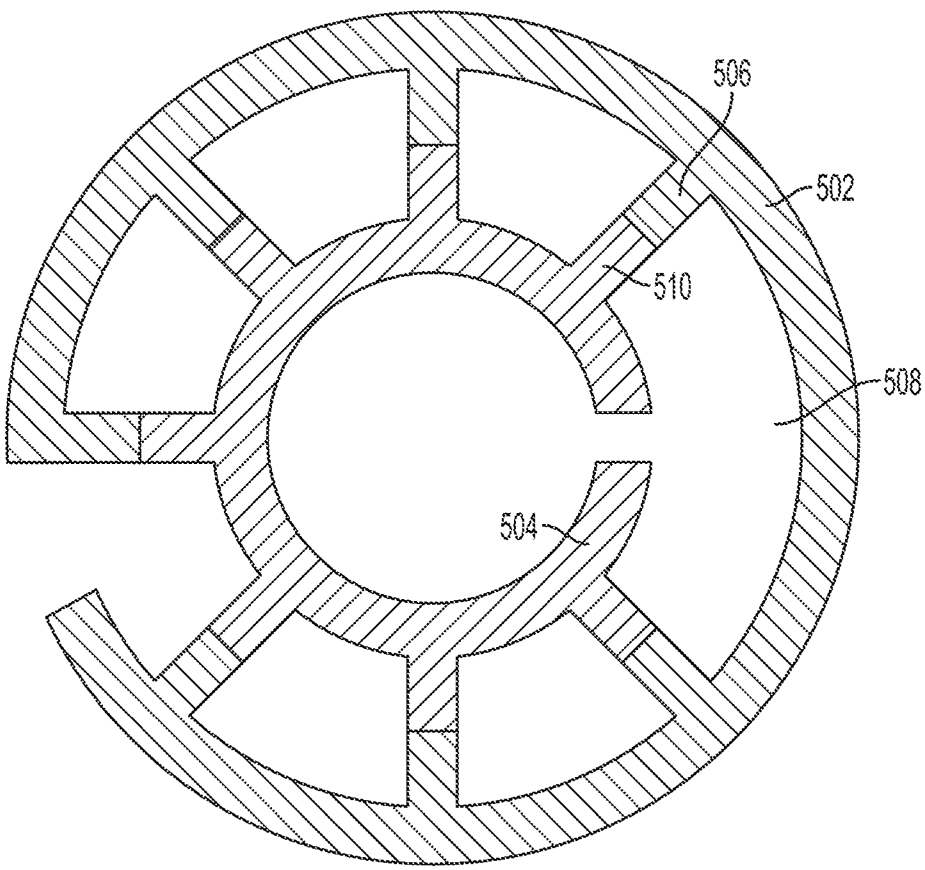

FIG. 10

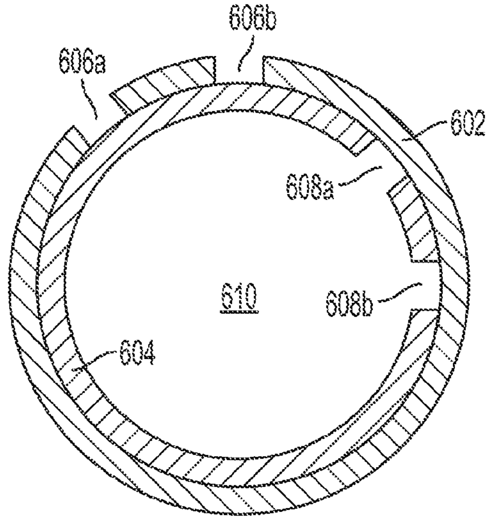

FIG. 11A

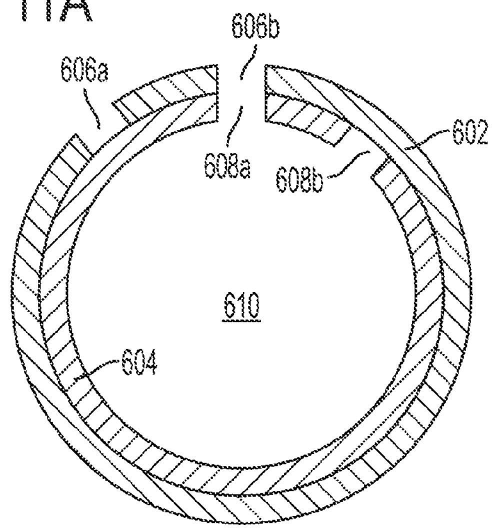

FIG. 11B

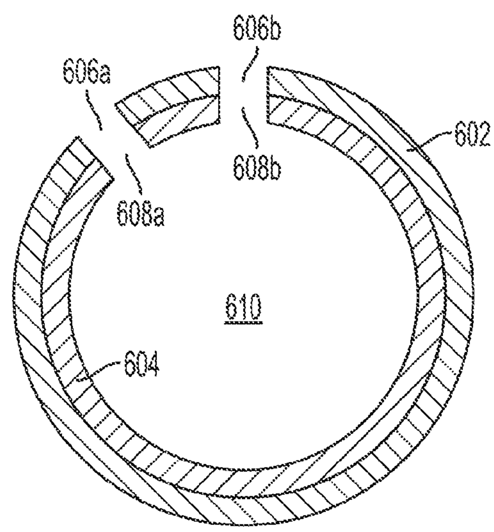

FIG. 11C

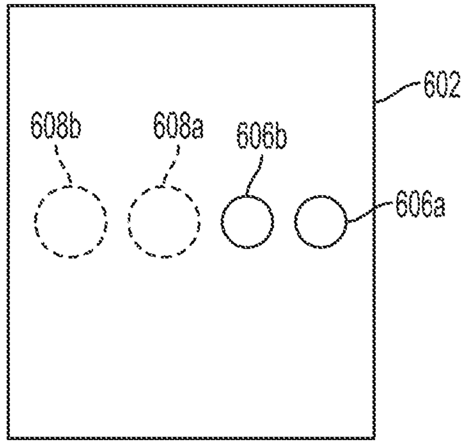

FIG. 12A

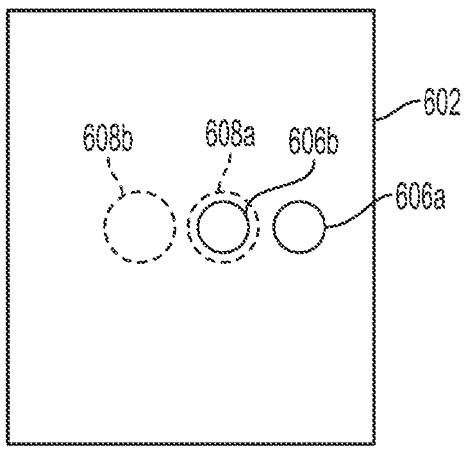

FIG. 12B

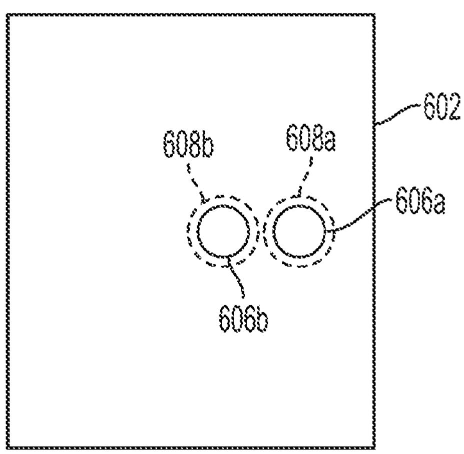

FIG. 12C

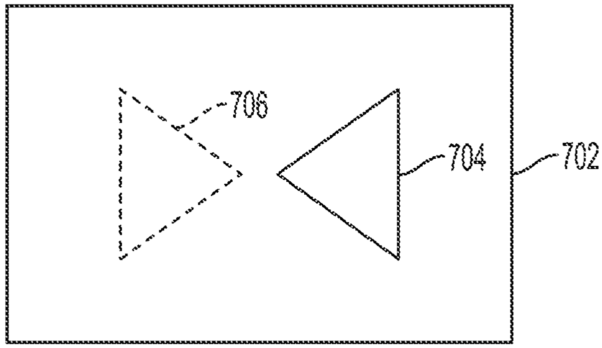

FIG. 13A

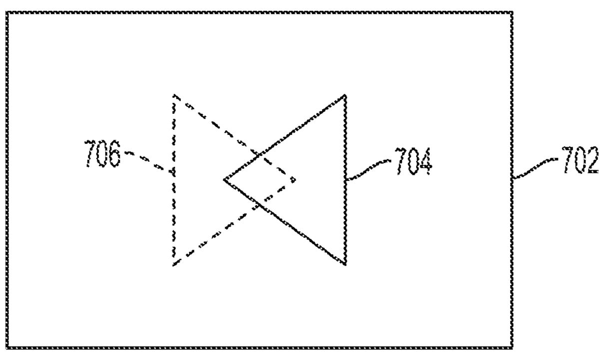

FIG. 13B

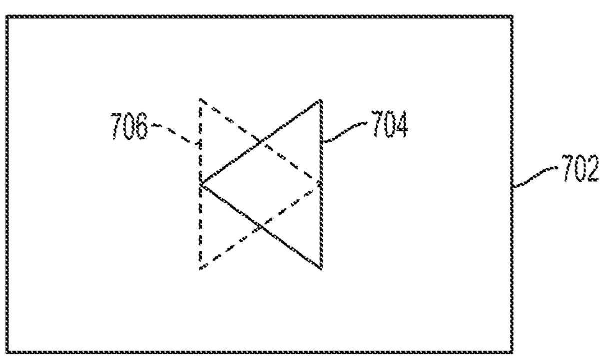

FIG. 13C

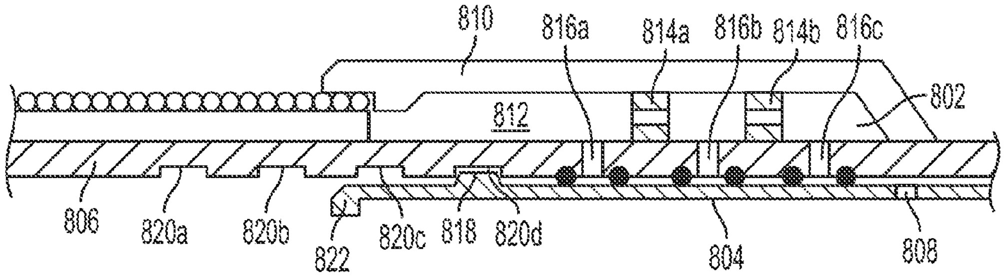

FIG. 14A

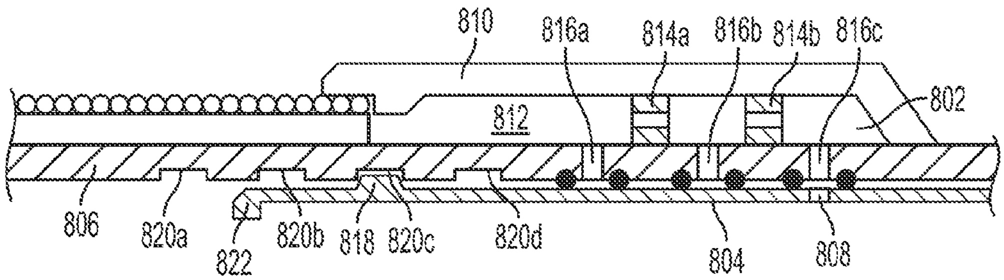

FIG. 14B

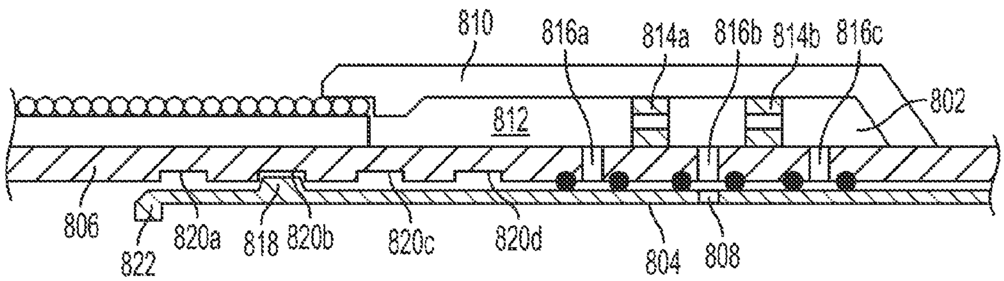

FIG. 14C

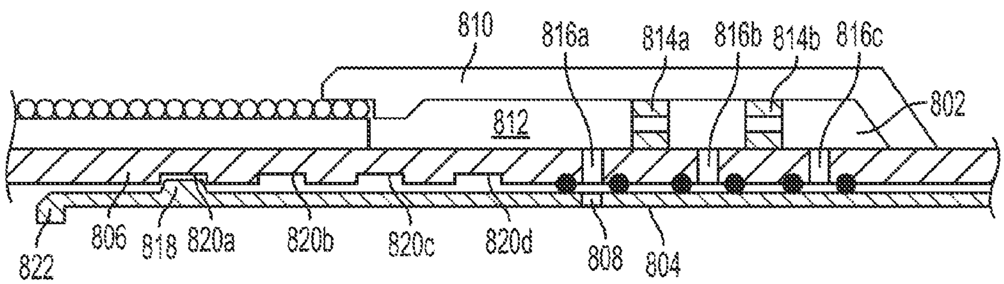

FIG. 14D

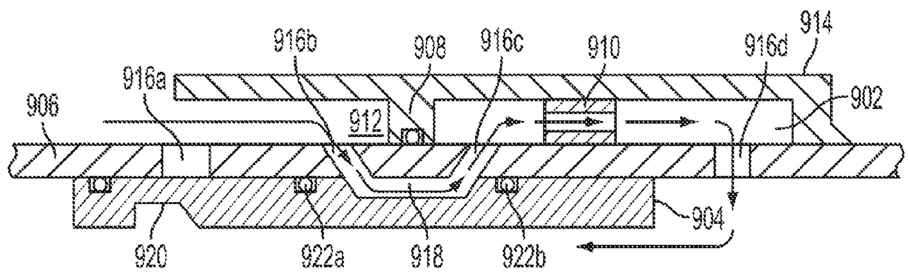

FIG. 15A

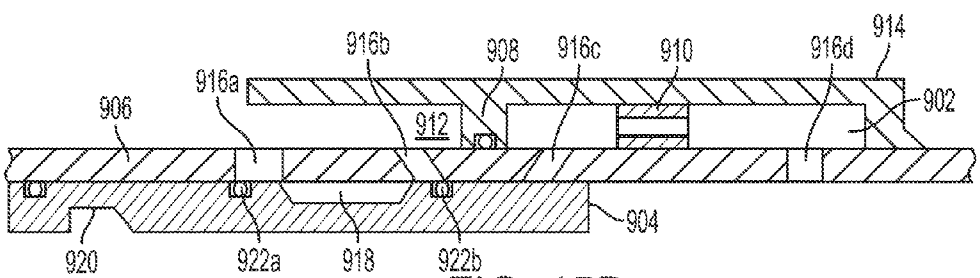

FIG. 15B

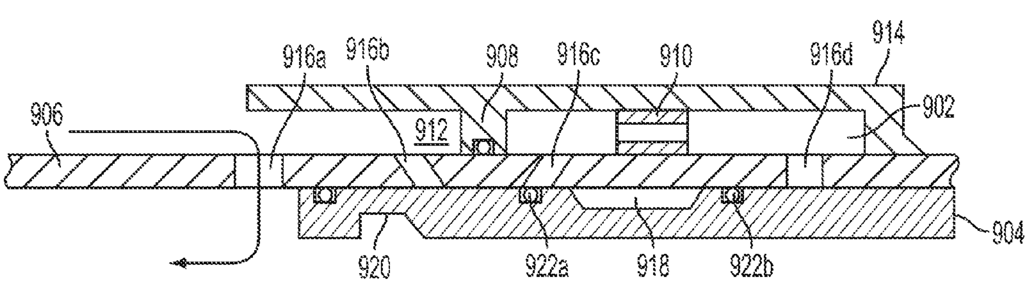

FIG. 15C

MECHANICALLY ADJUSTABLE FLOW CONTROL ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a U.S. national phase under 35 U.S.C. 371 of International Patent Application No. PCT/US2012/049829, titled "Mechanically Adjustable Flow Control Assembly," filed Aug. 7, 2012, the entirety of which is incorporated herein by reference.

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to assemblies for controlling fluid flow in a bore in a subterranean formation and, more particularly (although not necessarily exclusively), to assemblies that are mechanically adjustable while in the bore to change resistivity to fluid flow of the assemblies.

BACKGROUND

Various devices can be installed in a well traversing a hydrocarbon-bearing subterranean formation. Some devices control the flow rate of fluid between the formation and tubing, such as production or injection. An example of these devices is a flow control device or inflow control device that can be associated with a production interval isolated by packers and that can control production of fluid by creating a pressure drop of fluid flowing through the device.

For example, a flow control device can balance production by creating a pressure drop for reducing the production of some fluids, such as those having a higher concentration of water, for some period of time.

Adjusting a flow control device to respond to changing conditions in the well and to provide desired performance can be challenging. A flow control device may be adjusted at a surface of the well prior to being positioned in the well. Further adjustments subsequent to production may be prohibitively expensive, however, because the flow control device is adjustable only by removing it from the well and performing another adjustment at the surface. Some flow control devices can be adjusted while in the well via electronic control signals. These flow control devices, however, are operated outside of the production tubing.

Flow control assemblies are desirable that can positioned at least partly in a tubing and be adjusted while in the well among multiple positions to provide desired flow control performance.

SUMMARY

Certain aspects of the present invention are directed to a flow control assembly that can be mechanically adjusted, at least one of rotationally or translationally, inside a tubing downhole between multiple positions by an intervening tool from the surface to change resistivity to flow through the flow control assembly.

One aspect relates to a flow control assembly that can be disposed with tubing in a wellbore. The flow control assembly includes a first component and a second component. The first component has a first opening. The second component can be within the tubing and can have a second opening. The second component can be mechanically adjustable while in the wellbore by an intervening tool introduced in the tubing from a surface of the wellbore. The second component can be mechanically adjustable among physical positions with respect to the first opening for changing resistivity to fluid flow through a flow path through the first opening and the second opening.

Another aspect relates to a flow control assembly that can be disposed in a wellbore. The flow control assembly can include a component and a sleeve. The component can have an opening defining a flow path. The sleeve can have a sleeve opening and can be disposed in an inner area of a tubing. The sleeve can be mechanically adjusted at least one of rotationally or translationally with respect to the component by an intervening tool in the inner area of the tubing for changing resistivity to fluid flow through the flow control assembly by changing a position of the sleeve opening with respect to the opening.

Another aspect relates to a flow control assembly that can be disposed within a wellbore. The flow control assembly includes a component, a tubing portion, and a sleeve. The component has an opening defining a flow path. The sleeve has a sleeve opening and is disposed in an inner area of the tubing portion. The sleeve is mechanically adjustable at least one of rotationally or translationally with respect to the component (i) while in the wellbore by an intervening tool introduced from the surface of the wellbore and in the inner area of the tubing portion and (ii) among a plurality of physical positions with respect to the component for changing resistivity to fluid flow through the flow control assembly by changing a position of the sleeve opening with respect to the opening.

These illustrative aspects and features are mentioned not to limit or define the invention, but to provide examples to aid understanding of the inventive concepts disclosed in this disclosure. Other aspects, advantages, and features of the present invention will become apparent after review of the entire disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic illustration of a well system having production internals in which are flow control assemblies according to one aspect of the present invention.

FIG. **2** is a cross-sectional view of a flow control assembly and an intervening tool in a wellbore according to one aspect of the present invention.

FIG. **3** is a partial cut-away view of a flow control assembly according to one aspect of the present invention.

FIG. **4** is a cross-sectional view along line A-A in FIG. **3** according to one aspect of the present invention.

FIG. **5** is a perspective view of components of a flow control assembly in an open position according to one aspect of the present invention.

FIG. **6** is a cross-sectional view of the components of FIG. **5** according to one aspect of the present invention.

FIG. **7** is a perspective view of the components of FIG. **5** in a resistive position according to one aspect of the present invention.

FIG. **8** is a cross-sectional view of the components of FIG. **7** according to one aspect of the present invention.

FIG. **9** is a cross-sectional view of sleeves of a flow control assembly according to one aspect of the present invention.

FIG. **10** is a cross-sectional view of sleeves of a flow control assembly according to another aspect of the present invention.

FIG. **11**A is a cross-sectional view of sleeves of a flow control assembly in a closed position according to one aspect of the present invention.

FIG. **11**B is a cross-sectional view of the sleeves of FIG. **11**A in a first open position according to one aspect of the present invention.

FIG. **11**C is a cross-sectional view of the sleeves of FIG. **11**A in a second open position according to one aspect of the present invention.

FIG. **12**A is a side view of the sleeves of FIG. **11**A in a closed position according to one aspect of the present invention.

FIG. **12**B is a side view of the sleeves of FIG. **11**A in a first open position according to one aspect of the present invention.

FIG. **12**C is a side view of the sleeves of FIG. **11**A is a second open position according to one aspect of the present invention.

FIG. **13**A is a side view of sleeves of a flow control assembly with windows in a closed position according to one aspect of the present invention.

FIG. **13**B is a side view of the sleeves of FIG. **13**A in a first open position according to one aspect of the present invention.

FIG. **13**C is a side view of the sleeves of FIG. **13**A is a second open position according to one aspect of the present invention.

FIG. **14**A is a cross-sectional side view of part of a flow control assembly in a closed position according to another aspect of the present invention.

FIG. **14**B is a cross-sectional side view of the flow control assembly of FIG. **14**A in a first open position according to one aspect of the present invention.

FIG. **14**C is a cross-sectional side view of the flow control assembly of FIG. **14**A in a second open position according to one aspect of the present invention.

FIG. **14**D is a cross-sectional side view of the flow control assembly of FIG. **14**A in a third open position according to one aspect of the present invention.

FIG. **15**A is a cross-sectional side view of part of a flow control assembly in a first open position according to another aspect of the present invention.

FIG. **15**B is a cross-sectional side view of the flow control assembly of FIG. **15**A in a closed position according to one aspect of the present invention.

FIG. **15**C is a cross-sectional side view of the flow control assembly of FIG. **15**A in a second open position according to another aspect of the present invention.

DETAILED DESCRIPTION

Certain aspects and features relate to a flow control assembly that can be mechanically adjusted inside a tubing downhole between multiple positions by an intervening tool from the surface to change resistivity to flow through the flow control assembly. The positions among which the flow control assembly can be adjusted can include a closed position, a fully open position, a position at which the fluid flow experiences a first pressure drop, a position at which the fluid flow experiences a second pressure drop, etc. A pressure drop may be the result of a flow path being partially, but not fully, open, which includes devices in the flow path or physical characteristic of the flow path causing the pressure drop. A flow control assembly according to some aspects may be or include an inflow control device and may be part of a tubing, such as a production tubing. An intervening tool may be a device positioned downhole using a slickline, electric line, coiled tubing, or other type of method of conveyance.

The flow control assembly may be mechanically adjusted by moving a component of the flow control assembly rotationally or translationally. The flow control assembly can include a sleeve with an opening. A position of the sleeve relative to another component of the flow control assembly with an opening can be mechanically adjusted rotationally or translationally using an intervening tool to change a flow path of fluid flowing through the flow control assembly, or otherwise changing the resistivity of the flow control assembly with respect to the fluid.

In some aspects, the sleeve is an inner sleeve and the other component is an outer sleeve. The inner sleeve can be rotated by the intervening tool to change the position of the inner sleeve with respect to the outer sleeve. Changing the position of the inner sleeve with respect to the outer sleeve can result in the opening of the inner sleeve changing position with respect to the opening in the outer sleeve, or otherwise changing a flow path of fluid flowing through the flow control assembly.

In one aspect, the flow control device includes a chamber between the inner sleeve and the outer sleeve. Protrusions (also referred to as "teeth") from one or both of the inner sleeve and outer sleeve can extend into the chamber. For example, protrusions can extend from the outer wall of the inner sleeve into the chamber and protrusions can extend from the inner wall of the outer sleeve into the chamber. Changing the position of the inner sleeve with respect to the outer sleeve can result in a position of the inner sleeve protrusions changing with respect to the outer sleeve protrusions, which can result in a change to the flow path of fluid flowing through the flow control assembly. For example, the protrusions, relative to each other, can result in a tortuous flow path or can result in one or more orifices that can affect fluid flow.

In other aspects or additionally, the sleeve can be adjusted translationally such that a position of the opening in the sleeve can change with respect to one or more openings in a housing defining a flow path and one or more openings in tubing. Adjusting the sleeve translationally can include moving the sleeve horizontally (or vertically as the case may be) with respect to the housing.

For example, the housing, which may be a flow restriction sub-assembly, can define a flow path in which is disposed one or more flow restrictors. A flow restrictor can restrict flow by a certain amount. An example of a flow restrictor is a choke or a valve. Changing the position of the opening in the sleeve can result in a change to the amount of restriction fluid experiences through the flow path of the housing.

In some aspects, the opening of the sleeve is a bypass channel in an outer wall of the sleeve that, when positioned, can provide a bypass channel for fluid flow around a flow blocker that can be disposed in the flow path of the housing.

A sleeve may be an at least partially circumferential structure that can be located within a tubing string or flow control assembly in a wellbore. A sleeve can be made from any suitable material. An example of suitable material is stainless steel.

These illustrative examples are given to introduce the reader to the general subject matter discussed here and are not intended to limit the scope of the disclosed concepts. The following sections describe various additional features and examples with reference to the drawings in which like numerals indicate like elements, and directional descriptions are used to describe the illustrative aspects but, like the illustrative aspects, should not be used to limit the present invention.

FIG. **1** depicts a well system **100** with flow control assemblies according to certain aspects of the present invention. The well system **100** includes a bore that is a wellbore **102** extending through various earth strata. The wellbore **102** has a substantially vertical section **104** and a substantially horizontal section **106**. The substantially vertical section **104** and the substantially horizontal section **106** may include a casing string **108** cemented at an upper portion of the substantially vertical section **104**. The substantially horizontal section **106** extends through a hydrocarbon bearing subterranean formation **110**.

A tubing string **112** extends from the surface within wellbore **102**. The tubing string **112** can provide a conduit for formation fluids to travel from the substantially horizontal section **106** to the surface. Production tubular sections **114** in various production intervals adjacent to the formation **110** are positioned in the tubing string **112**. On each side of each production tubular section **114** is a packer **118** that can provide a fluid seal between the tubing string **112** and the wall of the wellbore **102**. Each pair of adjacent packers **118** can define a production interval.

One or more of the production tubular sections **114** can include a flow control assembly. The flow control assembly can be mechanically adjusted by an intervening tool introduced into the bore from the surface to change a flow path from the subterranean formation to an internal production flow path in the tubing.

Although FIG. **1** depicts production tubular sections **114** that can include flow control assemblies positioned in the substantially horizontal section **106**, production tubular sections **114** (and flow control assemblies) according to various aspects of the present invention can be located, additionally or alternatively, in the substantially vertical section **104**. Furthermore, any number of production tubular sections **114** with flow control assemblies, including one, can be used in the well system **100** generally or in each production interval. In some aspects, production tubular sections **114** with flow control assemblies can be disposed in simpler wellbores, such as wellbores having only a substantially vertical section. Flow control assemblies can be disposed in open hole environments, such as is depicted in FIG. **1**, or in cased wells.

FIG. **2** cross-sectionally depicts part of a production interval according to one aspect. The production interval includes a tubing string **112** that has a production opening **202** through which fluid can flow from a formation. Disposed in an inner area **203** of the tubing string **112** is a flow control assembly **204**, or part of a flow control assembly **204**, an intervening tool **206**, and a line (or lines) **208** for the intervening tool **206**. The line **208** can be used to run the intervening tool **206** from the surface into the tubing string **112**. The intervening tool **206** can cooperate with the flow control assembly **204** and, in response to movement of the intervening tool **206** from the surface, cause at least part of the flow control assembly **204** to change position.

The intervening tool **206** can include pins **210***a*, **210***b* or other components extending from the intervening tool **206** that can interface with slots **212***a*, **212***b* or other structures of the flow control assembly **204** to cause at least part of the flow control assembly **204** to change position. The intervening tool **206** may be a shifting tool that can cause part of the flow control assembly **204** to change position. For example, one or more of the slots **212***a*, **212***b* on an inner wall of part of the flow control assembly **204** can have a pattern such that as the intervening tool **206** is shifted downward (away from the surface), one or more pins **210***a*, **210***b* follows part of the pattern and causes at least part of the flow control assembly **204** to rotate.

FIG. **3** depicts a flow control assembly **302** according to one aspect. FIG. **3** depicts a cut-away view of the flow control assembly **302** on the left-hand side. On the right-hand side, FIG. **3** depicts a partial transparent view of the flow control assembly **302** via dotted lines. The flow control assembly **302** is shown disposed within a wellbore, and may be a subassembly of a tubing string. The flow control assembly **302** includes a housing **304** in which is disposed an outer sleeve **306**, an inner sleeve **308**, a shifting profile **312**, and return spring **314**. The outer sleeve **306** includes openings **316***a*, **316***b* and the inner sleeve **308** includes openings **318***a*, **318***b*.

The inner sleeve **308** can be rotationally moved or indexed such that the openings **318***a*, **318***b* in the inner sleeve **308** are positioned with respect to openings **316***a*, **316***b* in the outer sleeve **306** to provide a desired flow resistance or pressure drop. In some aspects, the inner sleeve **308** is moved clockwise by an intervening tool. For example, the inner sleeve **308** can include a profile **312** in an inner wall that can receive a pin of a J-slot mechanism through slot **310**. An intervening tool can cause the inner sleeve **308** to shift downward, which results in the J-slot mechanism rotating the inner sleeve **308** with respect to the outer sleeve **306**. In some aspects, the J-slot mechanism is associated with a hydraulic control line to the surface through which pressure control signals can be conveyed to the J-slot mechanism. The return spring **314** can push the inner sleeve **308** upward, returning the inner sleeve **308** to a position.

The outer sleeve **306** and the inner sleeve **308** can form a chamber that includes a flow path through which fluid can flow. By rotating the inner sleeve **308** with respect to the outer sleeve **306**, the resistivity to fluid flow in the flow path can change. FIG. **4** depicts a cross-sectional view of part of the flow control assembly **302** along line A-A in FIG. **3** that includes the outer sleeve **306** and inner sleeve **308**. A chamber **320** that includes a flow path is defined between the outer sleeve **306** and the inner sleeve **308**. Fluid can flow into the flow path of the chamber **320** from openings **316***a*, **316***b* and can flow through the flow path of the chamber **320** to openings **318***a*, **318***b* that allow fluid to flow to an inner area of the tubing.

Extending from the outer sleeve **306** into the chamber are protrusions **322**. Extending from the inner sleeve **308** into the chamber are protrusions **324**. Protrusions **324** can cooperate with protrusions **322** to create a tortuous flow path for fluid flowing through the chamber **320**, resulting in a reduced fluid velocity and creating a pressure drop by, for example, removing energy from the fluid flow. The amount of pressure drop may depend on the length of the flow path that fluid travels from openings **316***a*, **316***b* to openings **318***a*, **318***b*. Protrusions **324** can change position with respect to protrusions **322** as the inner sleeve **308** is rotated and increase or reduce the amount of pressure drop, as needed.

FIG. **4**, for example, depicts fluid flow using arrows. Fluid can flow into openings **316***a*, **316***b* in the outer sleeve **306** and be directed by protrusions **322** cooperating with protrusions **324** toward one or more of openings **318***a*, **318***b* in the inner sleeve through the chamber **320**. As the fluid flows toward openings **318***a*, **318***b*, the protrusions **322** and protrusions **324** can cooperate to create a tortuous flow path resulting in the fluid experiencing a pressure drop. Rotating the inner sleeve **308** with respect to the outer sleeve **306** can change the number of cooperating protrusions through which fluid flows.

The inner sleeve **308** can be rotated with respect to the outer sleeve **306** such that fluid is substantially prevented from flowing through openings **318***a*, **318***b* or fluid is substantially allowed to flow through openings **318***a*, **318***b* without restriction by cooperating protrusions. FIGS. **5-6** depict via the inner sleeve **308** rotated with respect to the outer sleeve **306** such that fluid is substantially allowed to flow through openings **318***a*, **318***b* in the inner sleeve **306** from openings **316***a*, **316***b* in the outer sleeve **306** without flowing through chamber **320**.

One or more protrusions of protrusions **322** and/or protrusions **324** can be configured to direct fluid in a direction within the chamber **320**. For example, one protrusion of protrusions **322** or protrusion **324** can extend further into the chamber **320** than some other protrusions and cooperate, such as by aligning, with another protrusion to prevent fluid flow in one direction in the chamber **320**. FIGS. **7-8** depict the inner sleeve **308** rotated with respect to outer sleeve **306** one hundred sixty degrees such that fluid flow can experience the highest flow resistance within the chamber **320** without flow being completely prevented. A protrusion **324***a* of inner sleeve **308** extends further into the chamber than at least some other protrusions **324** and can cooperate with protrusion **322***a* of the outer sleeve **306** to substantially prevent fluid from opening **316***a* from flowing in one direction in the chamber **320** and to direct fluid to flow in a second direction in the chamber **320**. Protrusion **324***b* of inner sleeve **308** extends further into the chamber than at least some other protrusions **324** and can cooperate with protrusions **322***b* of the outer sleeve **306** to substantially prevent fluid from opening **316***b* from flowing in one direction in the chamber and to direct fluid to flow in a second direction in the chamber **320**.

Although FIGS. **3-8** depict two openings for each of outer sleeve **306** and inner sleeve **308**, any number of openings including one of each can be used. Although a position of the inner sleeve **308** with respect to the outer sleeve **306** is described with respect to FIGS. **3-8** as resulting from rotating the inner sleeve **308**, certain aspects of the present invention can change a position of the inner sleeve **308** with respect to the outer sleeve **306** by rotating the outer sleeve **306** or by rotating both the outer sleeve **306** and the inner sleeve **308**.

A flow path in a chamber of a flow control assembly according to some aspects can resist fluid flow using types of resistances in addition to or other than by using a tortuous path. FIG. **9** depicts a cross-section of part of a flow control assembly that includes an outer sleeve **402** and an inner sleeve **404** that can cooperate to create orifices for resisting fluid flow. The outer sleeve **402** includes an opening **406** through which fluid can flow into the flow control assembly. The inner sleeve **404** includes an opening **408** through which fluid can flow from a flow path in a chamber **410** defined by the outer sleeve **402** and inner sleeve **404** into an inner area of tubing string.

The outer sleeve **402** includes protrusions **412** that can align with protrusions **414** of the inner sleeve **404** to create orifices **416** through which fluid can be directed to flow, or to block fluid flow. For example, protrusion **412***a* is aligned with protrusion **414***a* to create an orifice **416***a* through which fluid flows and can be restricted. The number of orifices **416** through which fluid is caused to flow can change by rotating the inner sleeve **404** with respect to the outer sleeve **402** and changing a position of the opening **408** with respect to opening **406**. Protrusion **412***b* is aligned with protrusion **414***b* to substantially block flow in one direction in the chamber **410**. Protrusion **414***b* may, for example, extend further into the chamber **410** than other protrusions **414** to cooperate with one of the protrusions **412** of the outer sleeve **402** to substantially block flow in one direction.

In other aspects, protrusions can align to substantially block fluid flow. FIG. **10** depicts a cross-section of an outer sleeve **502** and an inner sleeve **504**. The outer sleeve **502** includes protrusions **506** extending into a chamber **508** and cooperating with protrusions **510** extending into the chamber **508** from inner sleeve **504** to substantially block fluid flow. In some aspects, the inner sleeve **504** can be rotated with respect to the outer sleeve **502** such that the protrusions **510** are not aligned with protrusions **506**, creating a tortuous flow path through the chamber **508**.

In some aspects, openings in sleeves can be configured to allow an amount of resistivity of flow to change based on a position of the openings with respect to each other. FIGS. **11**A-**11**C depict via cross-section an outer sleeve **602** and an inner sleeve **604** of a flow control assembly. FIGS. **12**A-**12**C depict an outer wall of part of the outer sleeve **602**.

The outer sleeve **602** includes openings **606***a*, **606***b* through which fluid can flow. The inner sleeve **604** includes openings **608***a*, **608***b* through which fluid can flow to an inner area **610** of a tubing string. The inner sleeve **604** can be rotated with respect to the outer sleeve **602** to change the position of openings **608***a*, **608***b* with respect to openings **606***a*, **606***b* to change resistivity to fluid flow through the flow control assembly.

In FIGS. **11**A and **12**A, the flow control assembly is in a closed position. None of the openings **608***a*, **608***b* are aligned with one or more of openings **606***a*, **606***b* such that fluid is prevented from flowing to the inner area **610** of the tubing string. FIGS. **12**A-**12**C depict openings **608***a*, **608***b* using dashed lines to indicate the position of the openings **608***a*, **608***b* in the inner sleeve **604** that is disposed in an inner area defined by the outer sleeve **602**. In FIGS. **11**B and **12**B, the inner sleeve **604** is rotated to a position such that opening **608***a* of the inner sleeve **604** substantially aligns with opening **606***b* of the outer sleeve **602**, allowing fluid to flow to the inner area **610** of the tubing string while experiencing some amount of resistance due to the area of the flow path creating by opening **608***a* aligning with opening **606***b*. In FIGS. **11**C and **12**C, the inner sleeve **604** is rotated to an open position such that opening **608***a* of the inner sleeve **604** substantially aligns with opening **606***a* of the outer sleeve **602** and opening **608***b* substantially aligns with opening **606***b*. In an open position, fluid can be allowed to flow to the inner area **610** of the tubing string without substantial restriction, or at least with a lower or lowest amount of restriction provided by the flow control assembly.

In other aspects, the shape of openings can be configured such that as openings in sleeves align in response to rotation by an inner sleeve, the amount of resistivity to fluid changes. FIGS. **13**A-**13**C depict an outer sleeve **702** of a flow control assembly in which is located an inner sleeve that can be rotated with respect to the outer sleeve **702**. The outer sleeve **702** includes an opening **704** having a triangular shape as an example. The inner sleeve includes an opening **706**, shown by dotted lines to indicate the location of the opening **706** of the inner sleeve in an inner area defined by the outer sleeve **702**, that is triangular shaped. Although opening **704** and opening **706** are depicted as having a triangular shape, openings according to various aspects may have any suitable shape and may have different shapes.

In FIG. **13**A, the flow control assembly is in a closed position as the opening **704** and the opening **706** do not align, substantially preventing fluid from flowing through the flow control assembly to an inner area of a tubing string. In FIG. **13**B, the inner sleeve is rotated with respect to the outer sleeve **702** such that part of the opening **706** aligns with the opening **704**, providing a flow path for fluid through the flow control assembly to the inner area of the tubing string. The flow control assembly may resist fluid flow at least partially in this first opening position, based on a size of the flow path created by the opening **706** partially aligning with the opening **704**. In FIG. **13**C, the opening **706** substantially aligns with the opening **704** in the outer sleeve **702** such that an area of the flow path through the opening **706** and the opening **704** is increased and fluid experiences less resistance flowing through the flow control assembly to the inner area of the tubing string.

In some aspects, part of a flow control assembly can be adjusted translationally to change resistivity of the flow control assembly to fluid flow through the flow control assembly. FIGS. **14**A-**14**D depict via cross-section part of a flow control assembly that includes a flow restriction sub-assembly **802** and a sleeve **804**. The sleeve **804** is internal to a tubing string **806** and the flow restriction sub-assembly **802** is external to the tubing string **806**. The sleeve **804** includes an opening **808** and can be adjusted translationally with respect to the flow restriction sub-assembly **802** to change resistivity to fluid flow through the flow control assembly. Although sleeve **804** is depicted as including one opening **808**, sleeves according to some aspects include more than one opening.

The flow restriction sub-assembly **802** includes a housing **810** defining a flow path **812** through which fluid can flow. In the flow path are disposed flow restrictors **814***a*, **814***b*. A flow restrictor can be configured in shape or otherwise to restrict fluid flow by a certain amount. An example of a flow restrictor is a choke assembly. Although FIGS. **14**A-**14**D depict two flow restrictors, any number of flow restrictors can be used. The flow restriction sub-assembly **802** includes openings such as passages **816***a*, **816***b*, **816***c* that align with openings in the tubing string **806** to provide a flow path for fluid. Passage **816***a* may be closer to a source of fluid than the other passages and the flow restrictors **814***a*, **814***b*.

The sleeve **804** includes a ridged portion **818** that can engage gaps **820***a*, **820***b*, **820***c*, **820***d* in an inner wall of the tubing string **806**. In FIG. **14**A, the ridged portion **818** engages gap **820***d* and the sleeve **804** is in a closed position. In a closed position, the opening **808** in the sleeve **804** is not aligned with any of the passages **816***a*, **816***b*, **816***c* in the flow restriction sub-assembly **802** such that fluid flow through the flow path **812** is substantially prevented from flowing through the opening **808** to an inner area of the tubing string **806**.

The sleeve **804** can include an engagement member **822** that can engage an intervening tool in the wellbore and can allow a position of the sleeve **804** to be adjusted translationally. In FIG. **14**B, the sleeve **804** is adjusted toward the surface such that the ridged portion **818** engages gap **820***c*. In this position, the opening **808** in the sleeve **804** aligns with passage **816***c* in the flow restriction sub-assembly **802** to provide a flow path for fluid from the flow path **812** in the flow restriction sub-assembly **802** to an inner area of the tubing string **806**. The fluid flowing through the flow path **812** flows through flow restrictors **814***a*, **814***b* and experiences a level of restriction from both flow restrictors **814***a*, **814***b*.

In FIG. **14**C, the sleeve **804** is adjusted toward the surface such that the ridged portion **818** engages gap **820***b* and the opening **808** in the sleeve **804** aligns with passage **816***b* in the flow restriction sub-assembly **802** to create a flow path for fluid to enter the inner area of tubing string **806**. In this position, at least some of the fluid can flow through **808** without flowing through flow restrictor **814***b*. Fluid can flow through flow restrictor **814***a*, but experiences less resistance than in FIG. **14**B because fluid is not required to flow through flow restrictor **814***b* prior to flowing through opening **808**.

In FIG. **14**D, the sleeve is adjusted toward the surface such that the ridged portion **818** engages gap **820***a* and the opening **808** in the sleeve **804** aligns with passage **816***a* in the flow restriction sub-assembly **802** to create a flow path for fluid to enter the inner area of tubing string **806**. This position may be a substantially open position in that fluid is not required to flow through flow restrictor **814***a* or flow restrictor **814***b* prior to flowing through opening **808** to the inner area of the tubing string.

FIGS. **15**A-C depict part of a flow control assembly according to another aspect. The flow control assembly includes a flow restriction sub-assembly **902** disposed external to a tubing string **906** and a sleeve **904** disposed internal to the tubing string **906**. The flow restriction sub-assembly **902** includes a flow blocker **908** and a flow restrictor **910** disposed in a flow path **912** defined by a housing **914** and the tubing string **906**. The flow blocker **908** may substantially prevent fluid from flowing from one side of the flow blocker **908** to another side of the flow blocker **908**. In some aspects, the flow blocker **908** is part of the housing **914**. The flow restriction sub-assembly **902** also includes openings such as passages **916***a*, **916***b*, **916***c*, **916***d* that correspond to openings in the tubing string **906**.

The sleeve **904** includes an opening that is a bypass channel **918** on an outer wall of the sleeve **904**. The sleeve **904** also includes an engagement member **920** on an inner wall of the sleeve **904**. The engagement member **920** can engage an intervening tool in an inner area of the tubing string to adjust a position of the sleeve **904** translationally with respect to the flow restriction sub-assembly **902** and change resistivity of the flow control assembly to fluid flow.

In FIG. **15**A, the sleeve **904** is at a position such that the bypass channel **918** aligns at least partially with passages **916***b* and **916***c* to provide a bypass flow path for fluid through the flow path **912** from one side of the flow blocker **908** to another side of the flow blocker **908**. The sleeve **904** is also position such that fluid flow through passage **916***a* is substantially prevented. Fluid can flow through the bypass channel **918** to the other side of the flow blocker **908**, through flow restrictor **910** and through passage **916***d* to the inner area of the tubing string **906**. In this position, the fluid can experience resistivity to flow from the flow restrictor **910**. O-rings **922***a*, **922***b*, or other sealing mechanisms, can be included in the sleeve **904** to prevent fluid from flowing out of the bypass channel **918** except towards passage **916***c*.

In FIG. **15**B, the sleeve **904** is adjusted to a position such that the bypass channel **918** does not provide a flow path for fluid to flow from one side of the flow blocker **908** to the other side of the flow blocker **908** and the sleeve **904** can substantially prevent fluid from flowing through passage **916***a* in the flow restriction sub-assembly **902**. In this closed position, fluid may be substantially prevented from flowing through the flow control assembly to an inner area of the tubing string **906** by the sleeve **904** preventing flow through the passage **916***a* and the flow blocker **908** preventing flow to the other side of the flow blocker **908** that is farther from the source of the fluid.

In FIG. **15**C, a position of the sleeve **904** is adjusted such that the sleeve does not prevent fluid flow through the passage **916***a* in the flow restriction sub-assembly **902** and fluid is allowed to flow through the corresponding opening in the tubing string **906** to an inner area of the tubing string without substantial restriction.

Although FIGS. **15**A-**15**C depict a flow control assembly that includes one flow blocker **908**, one flow restrictor **910**, and one bypass channel **918**, any number of flow blockers, flow restrictors, and bypass channels can be used.

The foregoing description of the aspects, including illustrated aspects, of the invention has been presented only for the purpose of illustration and description and is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Numerous modifications, adaptations, and uses thereof will be apparent to those skilled in the art without departing from the scope of this invention.

What is claimed is:

1. A flow control assembly configured for being disposed with tubing in a wellbore, the flow control assembly comprising:

a first component having a first opening; and

a second component within the tubing, the second component having a second opening and being rotationally adjustable (i) while in the wellbore only by an intervening tool introduced in the tubing from a surface of the wellbore to rotate the second component mechanically and (ii) among a plurality of physical positions with respect to the first opening for changing resistivity to fluid flow through a flow path through the first opening and the second opening, the flow path including a first component flow path in fluid communication with the first opening and a second component flow path in fluid communication with the second opening,

wherein the second component is configured for being adjustable among the plurality of physical positions with respect to the first component for changing resistivity to fluid flow through the flow control assembly by changing a location of the second component flow path with respect to the first component flow path and changing a position of protrusions positioned in part of the flow path,

wherein the first component is one of an inner sleeve or an outer sleeve and the second component is the other one of the inner sleeve or the outer sleeve.

2. The flow control assembly of claim **1**, wherein the plurality of physical positions comprise:

a first position for closing the flow control assembly to fluid flow;

a second position for opening the flow control assembly to full fluid flow;

a third position for resisting fluid flow by a first pressure drop; and

a fourth position for resisting fluid flow by a second pressure drop.

3. The flow control assembly of claim **1**, wherein the second component is rotationally adjustable by the intervening tool among the plurality of physical positions with respect to the first opening for changing resistivity to fluid flow through the flow path by changing the flow path for fluid through the first opening and the second opening.

4. The flow control assembly of claim **1**, wherein the first component is the outer sleeve and the second component is the inner sleeve,

wherein the inner sleeve is rotationally and mechanically adjustable while in the wellbore by the intervening tool that is configured to rotate the inner sleeve among the plurality of physical positions with respect to the outer sleeve for changing resistivity to fluid flow through the flow path.

5. The flow control assembly of claim **4**, wherein the outer sleeve comprises outer protrusions extending toward the inner sleeve from the outer sleeve into a part of the flow path between the inner sleeve and the outer sleeve,

wherein the inner sleeve comprises inner protrusions extending toward the outer sleeve from the inner sleeve into the flow path between the inner sleeve and the outer sleeve,

wherein the inner sleeve is mechanically adjustable among the plurality of physical positions with respect to the outer sleeve for changing resistivity to fluid flow through the flow path by changing a location of the inner protrusions relative to the outer protrusions and by changing a location of the second opening of the inner sleeve relative to the first opening of the outer sleeve.

6. The flow control assembly of claim **5**, wherein at least one protrusion of the inner protrusions or the outer protrusions extends into the flow path between the inner sleeve and the outer sleeve more than at least some other protrusions of the inner protrusions and the outer protrusions,

wherein the at least one protrusion is configured to align circumferentially with another protrusion of the inner protrusions or the outer protrusions for preventing fluid flow in a first direction within the flow path between the inner sleeve and the outer sleeve.

7. The flow control assembly of claim **4**, wherein the intervening tool is configured to translate in the tubing for rotationally adjusting the inner sleeve with respect to the outer sleeve.

8. The flow control assembly of claim **4**, wherein the inner sleeve is rotationally and mechanically adjustable while in the wellbore by the intervening tool that is configured to rotate the inner sleeve among the plurality of physical positions with respect to the outer sleeve and change a location of the second opening of the inner sleeve with respect to the first opening of the outer sleeve for changing resistivity to fluid flow through the flow path.

9. The flow control assembly of claim **8**, wherein the first opening and the second opening are configured for providing an amount of resistivity to fluid flow that is based on an amount of alignment of the second opening with the first opening.

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